

T H E S I S

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PLUMBISM IN HUDDERSFIELD FROM LEAD POLLUTED WATER

There has been a great deal written about lead poisoning lately, but not so much I think about the chronic form of which those who practise in Huddersfield see so many cases.

Action of Huddersfield water on lead.

Huddersfield is supplied from the Deerhill, Blackmoorfoot, Wessenden & Longwood reservoirs, of which the first two are fed by surface water from the moorlands. The Geological formation is the millstone grit, but in many places the conduits are cut through beds of shale which contain iron pyrites, giving rise to ochery water. A considerable amount of peat also passes into the reservoirs. The Wessenden and Longwood water is obtained directly from springs. Analyses of Deerhill and Longwood waters made by Mr. Jarman our Analytical chemist, shew a great resemblance to those of the Sheffield supply from Redmires and Strines respectively. The Deerhill and Blackmoorfoot waters account for most of the cases of lead poisoning. The Wessenden and Longwood waters are very pure and act very little upon lead.

ANALYSIS BY MR. JARMAIN.

	Deerhill	Longwood.
Appearance in column two feet) in length)	Slightly turbid & of) a greenish colour)	Slightly turbid.
Total solids in grains per) gallon)	5.6	8.4
Loss on ignition	1.1	2.1
Chlorine estimated as chloride) of sodium, in grains per gallon)	1.23	1.48
On distillation the) free ammonia per Sample yielded) 1,000,000 parts.	0.26	0.10
	0.10	0.08
Hardness by Clarke's test	0.50	3.20
The inorganic matter contained compounds) of lime & Magnesia in grains per gallon.)	3.27	4.82
Reaction of water concentrated to 1/10 of) its volume by evaporation)	Acid	Slightly Alkaline

The main difference between those waters which act so strongly on lead and those which do not is the presence of free acid in the former. This acid is I think, the cause of the Plumbosolvent power of the water from the fact that its neutralization by carbonate of lime is producing a good effect, and will I think, when the deposit in the existing piping has disappeared, be followed by a better result still.

The acids are supposed to be sulphuric and nitric. If the water is evaporated to about a twentieth of its bulk, and tested with Chloride of Barium, it gives a white precipitate, which is insoluble on the addition of Hydrochloric or Nitric acid. A piece of paper put into the water further evaporated is charred. The Sulphuric acid comes from the large amount of coal smoke blown on to the moors and washed off by the rain, and from the iron pyrites through which the conduits are cut. Dr. Garrett in his work "The action of water on lead" says the Huddersfield water is acid to cochineal, very soft and like rain water. It contains Nitrate of Ammonium and but very little fixed mineral matter. It acts moderately on lead piping. He is inclined to regard the acid which occurs in lead dissolving water as of an inorganic rather than organic nature and in view of the fact that the water in question contains nitrate, he is of opinion that it is nitric acid. The idea of the existence of the so-called Peaty acids he rejects. Untreated Huddersfield water will dissolve if left in the pipe all night one grain per gallon for every 50 feet of Lead.

It is probable that the lead contained in Huddersfield water exists under two conditions, in solution, and in suspension; for on passing it through filter paper of three or four thicknesses, about half the lead is removed. The reservoirs are at such a height above the level of the town that the pressure on the pipes must be enormous, and it has been demonstrated that other things being equal pressure has an effect in helping water to dissolve lead. Another thing I have noticed is, that in

those pipes, where owing to being insecurely fastened, there is a great deal of vibration when the tap is turned the water contains more lead due to the inner coating of the lead piping being shaken off. New piping put into houses in place of old has caused several of my cases. It has been proved that the cheaper kinds of piping made from old melted up metal and probably not pure, dissolves more readily than the purer and more expensive kinds. This is explained by the fact that a galvanic action is set up by the impurities in the metal.

The method of examining water for lead which I have adopted, is the following:- Two grains of powdered crystallized Bichromate of Potassium is gently thrown on the suspected water in a conical precipitating glass, The same thing is done with a similar glassful of pure water. If the water contains as little as a fiftieth of a grain of lead per gallon, it will become sensibly turbid, and within twelve hours the precipitate will subside and the water may be poured off nearly to the last drop.

Estimation of lead in urine.

Take 700 c.c. urine.

Evaporate to drying on sandbath, then charring a little. Moisten the black residue with H.Cl, add water and boil, filter and wash with hot water. Discolourise the filtrate with a little Potassium Permanganate, remove some of the excess of acid by evaporation, leaving the filtrate faintly acid, making it up to 250 c.c. Stir this with a glass rod dipped in Ammonium Sulphide, and compare the deposit of sulphide with an equivalent quantity of water treated in a similar way, with Ammonium sulphide, a known quantity of solution of lead being added, and both being allowed to stand 12 hours.

During the last eight years, I have been practising in Huddersfield, I have seen many hundreds of cases of lead poisoning in my own practise, in the Infirmary, and shewn to me by medical men, who knew I was taking an interest in it. Of these I have taken notes of 300 cases. In many of the more obscure cases, it

has been impossible to tell that the patient was suffering from Plumbism, until the drinking water and the urine had been examined, and this has been done in all those cases where the disease was at all doubtful. Of my 300 cases, 80 were males and 220 females. The special commissioner of the British Medical Journal in his report from this district mentions 4 females to 1 male as being the ratio in which the sexes are attacked by plumbism, but I think 3 to 1 will be nearer the mark.

The following are the ages at which I have seen the cases.

300 Cases.

Under 5 years	3
5 to 10	18
10 " 15	26
15 " 20	30
20 " 25	60
25 " 50	133
50 " 60	30

Cases over 60 years of age are very rare.

From this it will be seen that from 20 to 50 years of age is a period of life when lead has the greatest effect upon the system nearly 200 out of the 300 occurring at that time, when all the tissues of the body are in their most highly developed condition. In children, the power of elimination is so great that I expect that is the reason they are not oftener effected, for if anything, they take more of the poison than adults. Plumbism is commoner amongst the poor than the rich, for two reasons, first that the well-to-do take greater precautions by using filters running the water off etc., second, that lead has a much greater and earlier effect upon an ill nourished half starved body, than one in a better condition. But poverty cannot be said to be the cause in Huddersfield, for the greater bulk of the operatives are well-to-do earning good wages and we have no portion of the town that can be considered insanitary. The longer the length of lead piping, the greater the liability to plumbism, consequently

you find that the people living in the end houses of a row are oftener effected than those situated nearer to the mains. I have never known symptoms of plumbism come on in less than 3 weeks after commencing to drink the water, and there are hundreds of people going about with distinct blue lines on their gums, who have been drinking the water for years who never complain of anything. February and September are the months we see the most cases, the months of the greatest rainfall with us.

In well marked cases of lead poisoning, there is a pale, expressionless, dejected look and a stooping attitude that is quite characteristic.

Unless accompanied by some other disease, plumbism does not cause an increase of temperature.

One of the first points that strikes us as to the action of lead is that the manner and rapidity of its ingestion modifies the character of the symptoms. If a large dose of a salt of lead be taken, the symptoms of acute irritant poisoning are set up, if minute doses of the poison are taken regularly for a long period, then the curious group of symptoms, known by the name of chronic lead poisoning are set up, and between the rapid acute symptoms and the slow chronic torment of minute doses there is every shade of gradation. In this town, acute lead poisoning is a rarity, although we have opportunities of studying the chronic poisoning in its most typical form, and I believe the plumbism produced by drinking water varies considerably from that acquired by lead workers. It is more chronic, more subtle and more likely to take on some protean form not at all suggestive of the symptoms of lead poisoning as laid down in books. We have all been taught the symptoms are colic, constipation, and a blue line on the gums with or without the attendant wrist drop. That such a description would accurately sum up a number of cases, perhaps a considerable majority of them, there is no doubt, and more particularly would it suffice for the cases of workers in lead, but in those poisoned by very small doses taken for a long

period of time the description would not apply to a large number. Undoubted lead poisoning occurs when colic is absent, or so infrequent as to be a very subsidiary element in the case, in fact, there is a pre-colic stage of lead poisoning as seen in Huddersfield. But though colic may be absent and wrist drop never threaten, constipation is almost invariable, and with the constipation there is often a peculiar malaise and depression, the patient seems disinclined for work, loves solitude, takes a gloomy view of life and may even lapse into a melancholic condition. Although, no doubt the impaired metabolism induced by the lead has a share in the production of the mental depression, I should be disposed to lay more of the blame for it upon the continual constipation. Other symptoms of Chronic plumbism that you would not expect to find are renal colic, spurious rheumatism, gout, asthma, great bodily weakness, syncope and sudden obstruction of the bowels, of which I shall give examples as we go through the various systems. In fact, so obscure, so insidious and so manifold are the symptoms of chronic lead poisoning, that I believe many people die from it without the real cause ever being suspected, and quite apart from actual sickness and death, I believe a great deal of the anaemia and physical degeneration so apparent in our large towns is due in a great measure to the continued and constant drinking of small quantities of lead polluted water, the amount of lead palsy and colic being by no means a true indication of the amount of plumbism in any district. The undermining of the system which results from chronic poisoning must obviously lessen the power of resistance to other diseases which the organism normally possesses, and there can be no reasonable doubt that the sick rate and even the death rate is in this way largely augmented in this district.

ALIMENTARY SYSTEM.

In the alimentary system we see some of the most noticeable effects of lead poisoning. The lips are nearly always pale and

dry, the breath is unpleasant, and there is a disagreeable, sweet metallic taste in the mouth, the teeth are often unsound and particularly is this the case with children in whom a peculiar form of caries is seen attacking the molar teeth at the junction of the crown with the fang; the gums may or may not present the blue line, I should say that quite half the cases of lead poisoning that one sees do not shew it, and yet many of these cases have been proved conclusively to be suffering from plumbism, by lead being found in the urine. I never saw the blue line on a child during its first dentition, though children do undoubtedly suffer from lead poisoning at that period of their lives.

The blue line is always associated with a deposit of tartar and the blue patches on the inside of the lips and cheeks are similarly connected. As shewn by Hilton Fagge, the blue line, though looking continuous is really made up of a series of blackish brown dots composed of minute granules of sulphide of lead. I think the lead gets there in two ways, first by a secretion in the saliva, which is absorbed by the mucous membrane of the gum, second as an albuminate from the blood of the vessels ramifying in the gum. The sulphur to form the sulphide comes first from the H_2S evolved in the decomposition of the animal matter contained in the pores of the tartar on the teeth, second from the saliva which contains enough sulphur charged proteid matter to generate by decomposition the required sulphide and also contains potassium sulphocyanide of which 130 millegrammes are secreted daily in health. This salt in aqueous solution decomposes with the evolution of ammonia, at ordinary temperatures, and it is not improbable that it is a contributor, if not the actual source of the sulphide which precipitates the lead in the gum. Doubtless microbes take part in this chemical change. It is a known fact that keeping the teeth and gums clean prevents the formation of the blue line, by preventing the formation of tartar, that nidus for stagnant and decomposing animal matters and sulphocyanides. These gain access to the tartar in two ways, first by being carried down with the lime salts when the tartar is being deposited on the teeth, second by absorption into the

pores of the tartar subsequently. "Bowman Vol 1 Lancet 1891 P.1039" Very commonly the blue line is absent from the gums of the front teeth, but may be seen alongside the molars, occasionally it may be found on the gum of the inner side of the teeth. The gums are frequently ulcerated and irregular in outline.

If the blue line is present it is evidence of constitutional affection, it is true it may not be accompanied by other manifest signs and symptoms, but it proves that the metal has been absorbed into the system and is slowly working mischief in the tissues. If the cause be removed, the blue line becomes bluish purple, purple, and then red, gradually disappearing, but I never saw it entirely disappear in less than a year. A symptom of lead poisoning in children is a crop of red excoriated ulcers varying from the size of a pin's head to a small pea, surrounded by a halo of whitish swollen mucous membrane. I have many times seen them, and children call attention to them from the fact that they are very painful, they may be in any portion of the mucous membrane of the mouth, but they seem to favour the neighbourhood of the opening into Stensen's ducts.

The tongue is dry and coated with brownish fur, the saliva is diminished in amount, and the mouth is dry. Not only is the amount of saliva diminished, but the quantity of sulphocyanide contained in it is also smaller. This I proved conclusively from a number of experiments which I performed on my own saliva, and that of patients suffering from plumbism that I could get it from. The starch converting power of the saliva is not diminished.

Sore throat is a frequent symptom of plumbism, brought on I think from the obstinate constipation. The appetite is almost invariably poor, and owing to the dryness of the mouth, thirst is often complained of. A feeling of sickness and emptiness before meals, followed by pain, flatulence, acidity and sickness after meals, is a frequent symptom, the last named being in some cases so exceedingly severe that the strength of the patient is often reduced to an alarming extent. The amount of gastric

juice is probably diminished. Dr. Oliver has shewn in his book on Lead Poisoning that the amount of lead dissolved by the gastric juice is much diminished if food is present with it, and in this way I account for the fact that we do not all suffer from plumbism, for we all drink the same water, and very few people comparatively take any precautions, and if it were not that we most of us take our liquids with solids, many more of us would suffer.

The secretions of the intestines and biliary secretions are diminished, shewn by the fact of the obstinate constipation and the dry pipeclay coloured appearance of the stools. Constipation is one of the most marked symptoms of the complaint, though occasionally, diarrhoea is complained of, though it is usually spurious set up by the presence of hardened fœces in the colon. I have had two cases in which the hardened fœces caused intense irritation of the colon leading to the passage of blood and mucus.

Constipation was present in quite three fourths of my cases, it is most distressing, the patients complaining that there is no power on the part of the bowel to expel the fœces, it seems paralysed. Aperients have very little effect simply setting up a little diarrhoea without expelling the main mass. The best treatment I have found is injections into the rectum of a hot solution of sulphate of magnesia.

The abdomen is frequently distended with gases, but during colic it is usually retracted and resistant to pressure.

COLIC.

This is one of the earliest and most frequent symptoms of the disease and was present in quite half my cases. It may be just a little mild griping, or may be agony, it is usually felt about the umbilicus, but other parts of the abdomen are just as commonly affected. It is usually relieved by pressure or warmth but there are cases in which either of these remedies seem to make it worse. It is apt to recur at particular times, especially at night. The pain of colic I believe to be merely a bad

form of the pain felt in ordinary flatulent colic, or the after pains of labour due simply to severe spasm of involuntary muscle.

In children under seven years of age, the commonest symptoms are colic, constipation, and ulceration of the mouth. I do not think constipation and colic necessarily dependant upon one another for you may have one without the other, or if they are both present, the pain may come first and the constipation afterwards, or vice versa. Following the colic there is often bilious vomiting. The following case illustrates how colic due to lead poisoning may be mistaken for biliary colic. J.R. aged 35, tall, stout, pale, sent for me complaining of an intense pain in the region of the gall bladder shooting towards the epigastrium. He had been suffering for some days from a feeling of sickness and pain after food. The tongue was coated blue line on gums, vomiting all his food, marked constipation, urine, loaded with urates. He was easily relieved with an injection of morphia and atropine. The next day the skin and conjunctiva were deeply tinged with bile and the case was put down as one of biliary colic, but unfortunately the attacks kept recurring, at intervals of about a weeks duration, the intervals gradually getting less, but the attacks following the same sequence, until it was discovered that he was the subject of plumbism, when all was soon put right. He had acquired the plumbism by taking a drink of cold water from the tap first thing in the morning.

I believe lead poisoning will cause a cirrhotic condition of the liver, but I have only felt that condition myself where alcoholism has been combined with plumbism.

I have had two cases in which plumbism has simulated acute abdominal obstruction.

A.T. butcher, short, stout, florid, sent for me complaining of a pain in the region of the umbilicus and bilious vomiting. He had been feeling ill for some weeks and his bowels has not acted for 14 days, no blue line on gums, abdomen retracted, passing small quantity of highly coloured urine. The next day the pain became unbearable, the vomiting increased until he could do

nothing else but reach, he became pale, cold and almost pulseless, temperature subnormal. The abdomen was hard and retracted he seemed on the point of death. I sent for a consultant, who decided to make an exploratory incision.

However, we delayed until the next day, when we found he had improved a little, but had developed wrist drop, and on enquiry we found that his hands had been growing more useless for some weeks. The urine was examined and found to contain lead. He made a good recovery.

M.S. Female, aged 40, thin and pale, had been suffering for 14 days from constipation and pain in the right umbilical region. At the time she was seen, the pain was excruciating, she was vomiting and heaving continually, she was cold, pale, and the pulse could hardly be felt, temperature sub-normal. She died in about an hour after being seen. Along with two other medical men, a post mortem was made. There was a broad blue line on the gums, on opening the abdomen the coils of the small intestine were found laid quite flat, apparently completely paralysed, containing nothing; there was no obstruction of any sort, the bladder contained no urine, the uterus was normal. We could find nothing to account for the death but lead poisoning. The drinking water contained lead.

HAEMOPOIETIC SYSTEM

Out of 220 females suffering from plumbism I found 25 with goitre, and of these the enlargement of the thyroid gland disappeared or became very much less in 14 after treatment. I have had one case of exophthalmic goitre.

S.B. aged 60, Female, thin and pale, thyroid gland moderately enlarged, eyes very prominent, complains of a feeling of fullness about the eyes, that they are very painful and water a great deal at nights, much palpitation, pulse 120 per minute. She also suffers from rheumatic pains in the limbs, no blue line, no colic and constipation absent. The drinking water and urine both contained lead. The lead polluted water was avoided, tonics

given, and in about six months some improvement was affected, the pulse had fallen to 90 per minute and the palpitation only occasionally complained of. At present she is nearly well. With reference to exophthalmic goitre Hilton Fagge in his "Principles and Practice of Medicine" P.1013 quotes Trousseau who says "that the three cardinal symptoms of this disease are due to disturbance of the lower cervical ganglia of the sympathetic." If this is the case, then I think there is no wonder that plumbism may cause it, for it seems to me that it is upon the sympathetic system that lead most strongly acts.

Anaemia is a common symptom of lead poisoning, occurring in about one third of my cases and connected with it is a dull, heavy, expressionless look; giving use to the name Saturnine Cachexia. I look upon anaemia as an indication that the ingestion of lead has been going on for some time, or else that the patient has absorbed a comparatively large quantity of the poison. Amongst children anaemia is one of the commonest symptoms. On examination of the blood, the rouleaux are found to be not perfectly formed and the number of red blood corpuscles is much diminished. Calculating them according to Gower's method the number per haemie unit varies from 50 to 90. The white blood corpuscles are not increased in some cases, whilst in others they are just as markedly increased.

Testing by Gower's haemoglobinometer the colouring matter of the blood was found to vary from 50 to 80 per cent of the normal quantity.

The blood serum contains a larger amount of urea than normal.

I think we may put down the anaemia in plumbism to four causes.

- 1 Diminished power of digestion and assimilation.
- 2 Lessened blood formation.
- 3 Increased loss from menorrhagia in females.
- 4 Increased amount of morbid products in the blood, due to the excretions of the bowels, kidneys, and skin being lessened.

It is wonderful how soon the number of red blood corpuscles increases when the bowels, kidneys and skin are made to act, long before the lead has disappeared from the system.

CIRCULATORY SYSTEM.

Pains in the precordiac of a dull aching shooting or burning character are common in plumbism and are usually put down to either dyspepsia or rheumatism. Palpitation is frequent and very distressing, as also is faintness and syncope, of which the following are examples: A.H. male, 19, extremely pale, sent for me when he had been suffering for 14 days from palpitation and faintness. I found him in bed looking very ill and unable to raise his head from the pillow for fear of attacks of syncope. On the slightest exertion he would lose consciousness and become almost pulseless. On examination I found a deep blue line on his gums, heart sounds very feeble, no wrist drop, he had had no colic, but constipation was marked. For a week his life hung in the balance, but eventually he got well. Lead was found both in the drinking water and the urine..

K.M. a young lady living in the country, sought advice for fainting attacks which came on quite suddenly, she had just had one and fallen from her horse, hurting her side severely. The side mended, but still the attacks of faintness continued, and in a short time she began to complain of indigestion, food for which she had no relish caused discomfort and flatulence, and along with it was great constipation followed by a melancholic condition in which the patient seemed to lose interest in everything and everybody. The fainting attacks came on so often that she dare not venture out alone, there was no anæmia, and the heart sounds were normal, no blue line, no colic, in fact nothing to suggest that lead was the cause of her illness. About 6 weeks after, she went to London, and whilst there she had severe abdominal pain, which returned every night, during the attacks of which she always fainted away, and in addition she had severe

nephralgia in the left side, the pain shooting down from the left groin, along the inguinal region to the pubes. This pain struck a consultant who was called in, as being very like some cases he had seen due to lead poisoning. This idea was acted upon, and not only was lead in abundance found in the drinking water, but the urine of the patient contained about one grain to each gallon. With the stoppage of the lead, the pain first of all disappeared, followed in turn by the fainting attacks, indigestion and constipation. The anaemia in this case was very slight, so I expect the heart's action must have been inhibited by stimulation of the vagus, through excessive stimulation of the gastric terminal branches of the sympathetic.

A similar case I had in a man aged 23, who had been drinking tap water for many years. Being out of work, he got a job on the roads helping to lay down gas pipes, the pipe joints were cemented with white lead, and he not being accustomed to the business was not particular in washing his hands before eating. He had been at this work about a fortnight, when he felt that his power of lifting and grasping the stamper, with which they stamp back the earth above the pipes was not so great, and he had to use both hands. In the middle of that night he sent for me and he looked like a dying man, he had severe colic, his face was excessively anxious, his breathing was about 120 to the minute and seemed to be entirely diaphragmatic, the muscles of the right side of the chest seemed paralysed and the left side movements were very slight, the pulse was very slow- about 45 per minute and so feeble that it could hardly be felt.

As injection of a quarter of a grain of morphia with a hundredth of a grain of atropia soon eased him, his breathing getting slower and the heart sounds better. The next day he was all right as far as his heart and chest were concerned, but paralysis of the extensions of both hands had set in, and now twelve months after it is only just beginning. ^{to improve} Owing to being out of work he had got half starved and I think he must have been suffering from plumbism from drinking water before he gave

himself the extra dose by working in lead.

The faintness caused by anaemia is frequently seen in lead poisoning. Palpitation and percussion of the heart reveal in many cases hypertrophy of the left ventricle, the apex beat being depressed and felt more to the left than normal, the heart's impulse increased, the first sound being booming and the second sound accentuated, but the cases I have seen have always been associated with alcoholism.

Anaemic murmurs are common, and I have heard both mitral and aortic murmurs, which upon treatment for lead poisoning disappeared, the following is an instance: J.S.H. 17, a thin, tall lad sent for me complaining of pains in his arms and legs, and that he passed very little urine. On examination the joints were not swollen, there was no temperature and no sour smell, anaemia very marked and urine scanty and high coloured. On examining the heart I found its action very violent, in the mitral area a soft blowing systolic murmur, aortic area a slight regurgitant murmur. Treatment by alkalies did no good, this led me to examine his gums carefully, and I found a blue line by the side of the molars, tap water was discarded and three months afterwards not a trace of a murmur could be heard. Throughout this case there was neither constipation nor colic,. I have seen three other cases in which heart murmurs have disappeared after treatment for plumbism.

Cases of irregular heart action due to plumbism are frequent- of which the following is a specimen:

A maiden lady 60 years of age gave the following history: She had been suffering for some months from weakness and a general feeling of illness, culminating in total want of appetite and pain in the abdomen, faintness and most troublesome and trying palpitation, the heart sounds were weak and irregular, the pulse was the same, arterial tension was increased, there was no blue line but colic and constipation were both present, and with this there were constant tremors of the limbs. The drinking water

was analysed and was found to contain $\frac{8}{10}$ of a grain of lead per gallon, and the urine contained over a quarter of a grain per gallon. The patient went from home, and in a few weeks was enjoying her usual good health.

In the British Medical Journal for March 1892, page 543 are the following references to an address given by Dr. Stewart "He says that lead is a more frequent cause of chronic endocarditis, than gout syphilis or alcohol. He recommends that in all cases of valvulites of seemingly obscure origin, the gums should be examined as a matter of routine. An abnormally forcible cardiac impulse, with accentuation of the aortic second sound and increased tension in the peripheral arteries is constantly present in many cases of lead cachexia. In these a tendency towards insidious valvular changes must be great, and this, favoured by the state of faulty nutrition, and anaemia always existing in such cases."

Increased pulse tension is so well known in plumbism that it is almost diagnostic.

The pulse tension is increased and the pulse rate decreased, and in addition the pulse is often feeble, and sometimes irregular.

The slowing of the pulse varies from about ten to thirty beats per minute less than the normal, and the increased tension which at first is usually associated with colic, comes in time to be a constant symptom. The tension of the two radial arteries is often different.

I have seen one case of angina pectoris due I think to lead poisoning.

J.W.D. 50, Tall stout man, had been suffering for three months, from dyspepsia and colic due to lead poisoned water, when he sent for me one night complaining of a feeling as if his heart was in a vice, he was very pale, his legs were drawn up, violent eructations of gas kept coming on, and he seemed to be in an agony. During the attack which lasted about fifteen minutes, the pulse

was 60 to the minute, tension increased, very weak and irregular, between the attack the pulse was weak, but otherwise normal. Respirations 40 per minute. For about a month, he would have as many as five or six attacks in the 24 hours, some being shorter—only about a minute in length, others longer than the first. A most curious circumstance was that some days he would have colic, and no angina, and other days just the opposite. He left the neighbourhood, but I afterwards heard that in about six months he entirely lost both colic and angina.

RESPIRATORY SYSTEM.

In this system, I think we see less of the effects of plumbism than in any other. I have mentioned one case under the circulatory system, in which the breathing was exceedingly rapid, 120 per minute, and in which the respiratory muscles, with the exception of the diaphragm, seemed to be entirely paralysed on one side, and partially so on the other.

Aphonia I have seen as a passing symptom in many cases.

T.A. male 40, suffered from dyspepsia and colic for twelve months, when loss of voice induced him to seek advice. I found a deep blue line on gums, colic and constipation both present, some weakness in the wrists, tendon reflexes absent in both knees, and a tendency to stumble forward in walking. On examination of the larynx I found the epiglottis paralysed, (food occasionally got into the windpipe,) and the vocal cords hanging loose, and could be seen to be depressed during inspiration, the voice was hoarse, and I put it down to paralysis of the superior laryngeal nerve. In about a month, the voice began to get better, but the wrist drop got worse, and he is still suffering from it.

I have seen two cases in which asthma was set up by plumbism.

W.H.H. female, 35. consulted me for weakness of the 4th. and 5th. fingers of the right hand, and for attacks of difficulty of breathing. There was paralysis of the 4th. and 5th. fingers of the right hand, and weakness in both wrists. The chest was ex-

amined, but nothing abnormal could be found.

Later on I saw her in one of her attacks; she began quite suddenly, complaining of a feeling of a load on her chest, the breathing was laboured and slow, wheezing could be heard all over the chest, no dullness. In about an hour the attack cleared off, and she was quite easy in her breathing. There was a copious expectoration of muco purulent phlegm directly the attack was over. Her father had suffered from asthma, but she had never the slightest symptom of it until she felt the weakness in her fingers. The attacks of asthma in her case seemed to take the place that colic would occupy in another person. Under treatment the paralysis gradually cleared, and the attack got milder, and in twelve months both had nearly disappeared.

The other case of asthma I have seen was very similar, wrist drop and difficulty of breathing, and in both these cases the drinking water and urine contained lead.

In Huddersfield and its neighbourhood, pulmonary phthisis is very frequent and is a large factor in the death rate. I think that there can be no doubt that, that the loss of appetite, anaemia and general debility caused by plumbism will cause an increased tendency to receive the infection, and a diminished power of resistance to it in any one attacked.

INTEGUMENTARY SYSTEM.

Hyperaesthesia and anaesthesia are occasionally observed in plumbism, but I will treat of them in the nervous system. The skin is pale, and often of an earthy hue, generally speaking, dry. Emaciation is general in males, but not so frequent in females. Odema of the hands, feet and face is seen in those cases associated with kidney mischief. Diaphoresis is very difficult to produce, and the sweat usually contains lead. One method of diagnosis in plumbism is that known as Ciceonardis and consists in painting the surface of the thorax with a 6 per cent solution of Sulphite of Soda. Give a dose of jaborandi or an injection of pilocarpine, and if lead is present in the tissues a dark discolouration caused by the formation of the sulph-

ide of lead soon makes its appearance.

URINARY SYSTEM

Nephralgia, and pain like the passage of a calculus down the ureter are rather frequent. Along with the pain there is for a time suppression of urine, making the case more difficult to diagnose. Nothing but the history of the case, and an examination of the gums, urine if possible, and drinking water, will give a clue to the real cause, for the pain is exactly the same, as in the passage of a calculus, and in the male the testicle is drawn up in just the same way. I believe the two pains to be caused by the same thing, spasmodic contraction of the ureter.

M.P. an elderly lady, was frequently having attacks of pain in the loins for which no definite cause could be assigned. The attacks extended over many months, and treatment gave no satisfactory relief,. They grew in intensity, the pain being of that acute prostatic character, and following the same anatomical distribution as renal colic.

Beyond constipation there was no other sign of plumbism, the patient being a stout ruddy faced woman. Fortunately a case of lead colic, associated with other symptoms of plumbism occurred in the same house, the drinking water, and urine of the patients was analysed and contained lead, and with the stoppage of the lead, both cases mended.

Lumbago put down to rheumatism has many a time failed to get better, until precautions were taken with the water.

Frequent micturition, particularly during the night is a common complaint, not only in those suffering from plumbism and albumen-urea, but in much less advanced cases, where there is no other symptom, but dyspepsia or constipation. This symptom is I think, due to the excessive acidity of the urine seen in plumbism. Inability to retain the urine, and difficulty in passing the whole of it, are also symptoms of the complaint. I have mentioned cases under the head of the nervous system.

URINE

This is altered in various ways. Specific gravity, colour, amount

of urea excreted, and the addition of albumen and sugar. Except in cases of chronic interstitial nephritis when it is increased, and in colic and during the interval between epileptic seizure, when it is much decreased, the amount of urine is not altered from the normal.

The specific gravity is nearly always lower, the average taken from a number of cases, being 1015.

The colour is generally paler. Urochrome is derived from the haemoglobin, and is the result of its disintegration by the liver, the urochrome is less, because of the saturnine anaemia, and consequently diminished functional activity of the liver.

Taking the average of a number of cases, I find the urea diminished by one third, and is probably from the same cause as the loss of urochrome, and from derangement of the renal apparatus.

It is usually ^{acid} in reaction, and after what may be termed an exposure in plumbism, such as a fit or attack of colic or severe attack of dyspepsia, the amount of uric acid is increased, a copious discharge of urates often taking place.

Albumenuria in plumbism is seen under three conditions.

1 A small amount is found in the urine of those in whom dyspepsia and constipation are symptoms, it may be present one day, and gone the next, but if the urine is carefully examined every day for a week or two, it nearly always makes its appearance.

2 It is found in varying quantities nearly always after an attack of colic or an epileptic seizure.

3. It is found in very small quantities in the urine of those suffering from chronic interstitial nephritis. I have never seen a case of the last variety, due to drinking lead polluted water only, except when there has been an antecedent history of kidney mischief from scarlet fever, measles &c.

I have seen several cases of glycosuria and two cases of diabetes apparently due to lead poisoning, and there is no doubt that the number of people suffering from sugar in the urine, either transitory or permanent is very large amongst us.

I have related one case under the reproductive system of a lady, who had first lead colic, followed in turn by glycosurea, album-enurea and puerperal eclampsia.

A.K. female, 47, sent for me complaining of what she called spasm of the stomach.

On enquiry and examination, I found a blue line, colic and constipation, the urine contained a diminished amount of urea, but no sugar.

She made satisfactory progress for about a month, when she came complaining that she had begun to pass a large amount of water, and that she felt very weak. On examining the urine again, I found the S.G. 1040 and it contained a large amount of sugar. She was passing 90 ounces of urine in 24 hours. I continued to treat her for lead poisoning, but gave her appropriate diet. She continued to pass a large amount of sugar for about a fortnight, when it gradually disappeared, along with the other symptoms of plumbism, and she is at present free from them all. I have had three other cases of similar passing glycosurea, and when you consider how glycosurea may be caused by injury to the nervous system, or by diminished liver function, I think there can be no doubt that plumbism may be one of the causes.

I have had two cases of diabetes along with lead poisoning running its usual course, and in one case ending in death.

M.A. female, aged 52, sent for me, complaining of colic and constipation. On examination, she had a marked blue line, and the wrists were a little weak. The urine at the time was quite free from sugar. She was apparently getting better, when she began to complain of pruritus, this led to the examination of the urine again, when it was found to contain much sugar, S.G. 1036, and passing 100 ounces a day. I thought the case would run the same course as the last, but though the colic and constipation are better, the urine still contains sugar. The S.G. is now 1026, and remains so as long as she keeps to the proper diet, but if she transgresses in any way, it returns to the higher specific gravity.

In neither of these cases was there a history of diabetes in the family.

Wm. M. boy, aged ten, came to the surgery one day and fell fast asleep. I noticed the peculiar odour of his breath, and had great difficulty in awakening him. He was sent home, and that same night, commenced with diabetic coma, and died in about twelve hours. His urine was found to be loaded with sugar and contained lead. A faint blue line on his gums led to the examination of the drinking water and urine. His friends said he had occasionally complained of stomach ache, but otherwise had been quite well. His father had had diabetes and I think the plumbism lighted a hereditary tendency, which perhaps would not have shewed itself for many years.

I have seen one case and heard of another in which blood in the urine was the most marked symptom of plumbism.

R. J. aged 65, male, when seen, had been suffering for three months from pain in the abdomen shooting down in the direction of the ureters. On examination, he was found to be very anaemic, no blue line, heart sounds feeble, and the area of the heart's impulse extended much beyond the nipple line, pulse irregular in force and rythm: Abdomen retracted and sensitive to touch, particularly in the region of the ureters. Urine contained a large quantity of blood and mucous. Bowels constipated. He gradually got weaker and died in a week. Both the drinking water, and urine contained lead. Temperature 99° F. Morning & 100° F. evening. The bleeding had been going on for about two months, and he said was always associated with the pain, when the pain was less, the bleeding was less.

REPRODUCTIVE SYSTEM

In this system, (with the exception of the nervous system) we see the greatest injury wrought by plumbism. Lead poisoning is a cause of sterility, it lowers the general vitality and virility of both sexes. The evidence is not so strong in the male, but

in the female, there can be no doubt of it. French observers have found that the wives of lead workers, not living anywhere near to the works frequently aborted, thus shewing that the spermatozoa must have been affected. The birth rate of Huddersfield for the year 1890 is only 22.6 per thousand compared with 30. per thousand for the twenty-eight great towns of England and Wales. This, I think, is due in a large amount to the effect of the lead polluted water on the male spermatozoa, and the female reproductive organs, and ova.

Oliver in his book on "lead poisoning" says in speaking of its effect upon animals "that stags like men have their reproductive organs affected by lead" Men that I have been attending for plumbism have informed me that the desire for sexual intercourse, is either greatly diminished or entirely absent.

Lead shews a great predilection for women during the period of active menstrual life. In the female, we find numerous subjective phenomena, such as pain in the loins, a bearing down feeling in the region of the perinaeum, and a hot burning feeling about the vagina. Lead disturbs the utero ovarian function, out of 220 females observed, quite half had some alteration of the menstrual function, the flow was altered in some way, either increased, diminished or entirely absent.

Usually there was first menorrhagia followed as the patient got more anaemic by amenorrhoea. In others, though the amount may be right, there is excessive pain, either before or during the flow. The following are examples of this form of plumbism.

M.M. 36 Domestic servant. had been suffering for twelve months with great pain, for two days before the menstrual flow came on. Lately the flow has been excessive, she states that she is a fortnight during which the discharge is very profuse, a week in which it is getting less, and a week free from it altogether. Very anaemic, blue line on gums. Suffers from dyspepsia and constipation, no colic, no wrist drop, reflexes normal. Under treatment for plumbism, and avoiding the poison, she gradually improved

and is now nearly well.

H.T. 34, Housewife, came complaining that for the last two years her periods had come on too frequently, and that for four months she had never been clear. Thin anaemie, with bad blue line on gums. Much dyspepsia, for some months, appetite bad, bowel moved every four days. Numbness on ulnar side of left arm, wrists weak, tendon reflex absent in left, but present slightly on right side, cramps in legs.

On examination of the uterus, I could find nothing to cause the hoemorrhage. Two years ago she moved into a row of new houses, and worse still, she occupied the end house in the row furthest from the main. The drinking water contained a quantity of lead. It took three months rest in bed, and treatment before the hoe-morrhage ceased, and at present she is making a good recovery.

Leucorrhoea is a frequent symptom, as is also great tenderness on pressure over the ovaries, and uterus. Miscarriages and abortions are extrememly frequent amongst the population here, not only in those women known to be suffering from plumbism, but in many others in whom in my opinion, the only symptom shewing that they are the subject of lead poisoning is the frequent recurrence of miscarriages, and a priori we might expect as much from the fact that lead lowers the vitality of both foetus and mother, causes anaemia, tendency to hoemorrhage with resulting inflammations of the uterus and decidua.

Again the vulnerability of a pregnant woman depends to a large extent upon the increased amount of effete material to be got rid of, and also upon the impaired power of excretion, now lead diminishes all the secretions and excretions, so I think there is no wonder that abortions are so frequent, where everyone is constantly taking lead.

The miscarriages usually take place about the third month, and the abortions generally soon after the time when the child would become viable. Those children born later in pregnancy before the

natural term never seem so well developed as they should be, and usually die from convulsions in an hour or two after birth.

I have dissected the placenta in some of these cases, and in the miscarriages, apoplexy of the placenta is the commonest cause, and in the abortions sclerosis of the placenta. I had one case of hydorrhoea gravidarium. The following are illustrations:

Mrs. F.M. 32, sent for me on the occasion of her fourth miscarriage, which had all taken place at the third month. Between her pregnancies she suffered greatly from menorrhagia. She had no blue line or other symptom of plumbism. On examining the drinking water, it contained 1 grain of lead per gallon. She gave up using the tap water, the menorrhagia gradually ceased, and in eighteen months she bore a living child, but it died from convulsions within a week of its birth. She is now pregnant again.

M.E.K. aged 30, was delivered of a fully developed child in 1884. Shortly after that she moved into a new house, and began using tap water. Within three months she became very anaemic, suffered from ill health, and constipation.

Menstruation never came on after she was confined, and in twelve months she became pregnant without ever having seen anything. She miscarried when she thought she was about the third month, with a tremendous amount of haemorrhage which threatened to take her life. Exactly the same sort of thing was repeated for four years, no catanaemia, pregnancy, miscarriage with much haemorrhage, until an attack of colic drew attention to the drinking water, and plumbism being diagnosed, precautions were taken. In the following year the same routine was gone through, and she was again threatened with miscarriage at the third month, but rest in bed for a month tided it over, and she was delivered of a child at full term. Lead poisoning was often suspected, but she declared she always took precautions with the water, and there was no blue line, in fact nothing to point to lead until the attack of colic, which was very severe. Dispensing with tap water, and using well water, has worked a most wonderful change

in her appearance.

Mrs. A.C. aged 28 has had two children, the last one in 1883. She came to consult me in 1886 for dyspepsia and constipation, she was also pregnant, but said she felt altogether different to her former pregnancies. On her gums was a marked blue line, and the urine on examination contained lead. It turned out that in her house, a pipe had lately burst, and it had been replaced by a new piece three yards long. She aborted at the fifth month with profuse hoemorrhage, and after the abortion and whilst she was still in bed, paralysis of the extensors of the hands came on. This gradually mended, but it was twelve months before she could use her needle again.

In the British Medical Journal for April 26, 1890, M. Paul states that in his investigations on the subject amongst lead workers, he saw in 123 pregnancies 64 abortions, with 4 premature labours and 5 still births. It is very difficult to get at any figures with regard to miscarriages and abortions, as so many are never seen by a medical man, but I should think that round about Huddersfield, that there are many more miscarriages than normal labours, for on asking married women that you find suffering from lead, they almost invariably have had miscarriages at some time. In those women who happen to be suffering from plumbism at full term the labour in my cases has been protracted, and they have required more help either with or without forceps.

I believe lead poisoning to be one of the causes of puerperal eclampsia, and I base my belief on the following grounds:

- 1 Tendency to albumenurea seen in plumbism.
2. High arterial tension seen in plumbism.
- 3 Tendency to convulsions seen in plumbism.
- 4 Seven cases that I have seen following plumbism.

Of these, seven cases, I will describe three, as I believe it to be a subject well worth enquiring into.

Mrs. B.B. aged 34, married ten years but no pregnancy. Early in 1888 owing to some colic, attention was drawn to the fact that all her married life, she had been drinking lead polluted water, she had a distinct blue line. This was attended to and in the following June she became pregnant. She was seen in January 13th. 1889 and was found to be suffering from dropsy of the lower extremities, some harsh breathing, a little cough, some sickness and diarrhoea. She was passing about half a pint of urine a day. S.G.1030, solid on boiling. pulse 84, tension greatly increased and temperature 98°4 °F.

January 14th. complained of indistinct vision, and great frontal headache. Urine still solid on boiling. January 15th. At 3 a.m. had a convulsion which lasted half an hour with a short interval of semiconsciousness, had no recollection of the fit, tongue bitten on the left side, still suffering from frontal headache. Pulse after fit 84. Respirations 26. Temperature 98.4. Face and hands oedematous, right lung less resonant than left, first heart sound prolonged, second accentuated, arterial tension increased, skin moist, foetal heart 128. She had no more fits, though she was again threatened with them on the 16th & 17th. and the urine, which had improved a little under treatment, on the 16th. again getting solid on boiling, on the 17th. premature labour was induced, and on the 19th. she was delivered of a very small male child.

After this, she made an uninterrupted recovery, the albumen gradually disappearing. The child lived, and is in every way sound and healthy. Here we have a case of sterility for ten years, caused I believe by lead polluted water, for on the removal of the cause, she soon became pregnant. She has had a subsequent confinement in every way normal.

Mrs. H. 38 Multipara. Has had three births at full term and two miscarriages. Previous health good until she had lead poisoning two years ago, when she had a miscarriage. Sight of one eye greatly impaired since plumbism. Ophthalmoscope shews optic atrophy.

Saw her on Oct. 15th. found her between 7 and 8 months advanced in pregnancy, complaining of severe pain in right hypochondrium shooting towards epigastrium, slight vomiting, some oedema of the ankles, urine albuminous one half S.G. 1028. passing 30 ounces in 24 hours. Second sound of heart accentuated, pulse 92, tension increased, Temperature 98°40°F. Later in the day the pain in the abdomen became easier, but severe frontal headache came on, and at nine in the evening she had a slight convulsion, after coming out of which she saw sparks before her eyes, at ten she had a severe convulsion lasting for thirty minutes.

Oct. 16th. At 12-15 a.m. had a slight convulsion, which seemed to be controlled by administering chloroform. The convulsions now got more frequent and longer, so premature labour was induced, and she was delivered at six p.m. She was very comfortable and quite conscious up to 9 p.m. when she was seized with a terrible pain in the epigastrium, chloroform was administered and she was kept partially under it for three hours, but immediately on removing it, she would call out in an agony of pain in the stomach.

Oct. 17th. At one a.m. injected morphia, which relieved the pain, but at two she had another severe convulsion, and from that time until four she was never free from them. They commenced in the right arm, extending down the body to the right leg, the face being very little affected and the left side free. She remained in a semi-conscious conditions until 4 a.m. on the 18th. when she became quite unconscious, pupils not sensitive, pulse very weak. At six a.m. had another convulsion, after which she again became slightly conscious, sufficient to call out of the intense epigastric pain. After this, she had fits every two hours, until nine in the evening when she died. She passed no urine during the last 48 hours, and after death, the bladder was found quite empty. There was no rise in temperature during the whole illness.

Mrs. W.F. 40 years, Multipara, first pregnancy sixteen years ago, last one five years ago. Two years ago had lead poisoning,.

During pregnancy had fair health. In January she had some dyspepsia, and on the 11th. the urine was tested and found to contain sugar, no albumen. S.G. 1030.

January 14th. S.G. 1026 and the sugar had disappeared. March 3rd. Labour commenced in the early morning, and was slow in the first stage but rapid in the second, she was delivered at 10-30 a.m., and felt quite well during the afternoon. At 7.30 in the evening she complained of pain in the head, and in a few minutes after she had a severe convulsion, lasting for a quarter of an hour, and during the next hour she had four more. The convulsions commenced in the left eye, spread to the muscles of the neck, and from there to the arms and legs, and the face was drawn to the left side. She had no more convulsions, though she was again threatened in the early morning of the 4th. During the day, she had several attacks of headache, with sparks in front of the eyes, but on chloroform being given followed by the administration of chloral hydrate, she became better. Urine. S.G.1010, about 1/8 albumen. After this she slowly improved, but for many days complained of the pain in her head and neck. Eyesight not affected, Temperature normal throughout.

In the whole of the seven cases, I have seen following plumbism, there has been no rise of temperature during the time that the convulsions were occurring. There has been marked albumen-urea in each case, with scanty urine, and the amount of urea greatly diminished, both absolute, and in proportion to the amount of urine. I look upon these cases as urinaemic as described by Parvin in his book on obstetrics where he uses the following expression. "The pregnant woman attacked with eclampsia in urinaemic. It is because there is an accumulation of all the elements of urine in the blood, that she is attacked by the final accident, known under the name of eclampsia. And I think this explains how plumbism may produce eclampsia, it is known to produce albumenurea, and to diminish the secretions, and excretions

of the body. Long after the coarser symptoms of lead poisoning, such as colic, and the blue line have disappeared, the effects of the lead remain, and what is more likely than that the onset of pregnancy may revive the symptoms of increased arterial tension, and diminished kidney excretion seen in lead poisoning.

NERVOUS SYSTEM

Neuralgia of the various nerves of the face, and shooting pains of a neuralgic character in the arms and legs are common in plumbism, due to the anaemia and lowered condition. I had one case of sciatica, when the patient had a blue line on the gums, and it resisted all treatment until the tap water was discarded. Frontal headache, generally due to constipation, cramp in the lower extremities, and tenderness of the muscles on being grasped are all symptoms complained of by patients. A feeling of heat I have only heard complained in the soles of the feet. A feeling of coldness, and a prickling sensation or sometimes numbness, are precursors of paralysis. These sensations are commonest on the ulnar side of the forearm, the backs of the hands and particularly the fourth and fifth fingers. Formication is common in old cases of paralysis. In one of my patients, in whom there was only paralysis of the extensors of one hand, there was anaesthesia and loss of muscular sense over the same area in the other hand. I have frequently seen the muscular sense of the hands affected when there was no motor paralysis.

Anaesthesia is fairly common in the arms, wrists and backs of the hands, sometimes in patches, sometimes the whole limb being affected. Hyperaesthesia is occasionally seen, one case I have mentioned under the Locomotory system; the tender points were the coracoid head of the biceps, and the origin of the extensors from the external condyle of the humerus.

There is no doubt that affections of the nerves of the eye and its appendages are common in plumbism. Partial paralysis of the third nerve I have seen several cases of, I have mentioned one

case of ptosis under the muscular paralys^{is}ts, diminished power of accomodation and irregularity of the pupils are frequently seen. I have noticed several cases of papillitis in patients the victims of plumbism, without the sight being apparently affected, and I had one case of total blinding, for 24 hours before a convulsion, without any change in the disc at all.

In general practice I only see the milder forms of eye affection, but Mr. Bendelack Hewitson, consulting ~~ophthal~~mic surgeon to the Leeds Infirmary, who has a large eye practice, informs me that he has great numbers of cases from Huddersfield, suffering from various eye affections, from diminished sight to total blindness, due entirely to drinking the lead polluted water.

Mr. Jonathan Hutchison makes the following remarks in the Ophthalmic hospital reports Vol.7.Part 1.page 6. "Amongst the peculiar ophthalmic features of plumbic neuritis we may mention:

- (a) The small amount of lymph usually present
- (b) Absence of colour in the lymph
- (c) Absence (not invariable) of extravasations of blood
- (d) The early and great diminution in size of the arteria and vena centralis. The choroid does not appear to be in the least implicated."

Hearing and smell not affected, and the power of taste not diminished, but ~~then~~ often a peculiar metallic taste in the mouth.

The only organic reflexes I have seen affected are breathing and micturition. All the muscles of inspiration on one side seemed perfectly paralysed in the case of the man I have recorded under the circulatory system. Inability to retain the urine I have heard complained of by several females, and inability to pass the whole of the urine, was seen in two males and one female. I withdrew residual urine from all these cases, and in each case it contained lead.

The only skin reflex I found frequently absent is the scapular. The patellar tendon reflex I have tested in nearly all my cases, with the result that I found it absent in about one

third, and present in a varying degree in the other two thirds. In some cases where I put it down as present, it was very feeble and in others it was absent on one side and present on the other in several people it was excessive. The only relation I have seen between the knee jerk and lead poisoning, is that the more severe the case, the more likely it is to be absent, returning slowly as the case mends. I have seen no ankle clonus. I have had some difficulty in diagnosing some cases of lead poisoning from Locomotor Atascia, of which the following is a specimen: W.T. male, 55 years of age, complains of attacks of vomiting, inability to walk, and that there is a dark mass, something like a bunch of grapes always in front of his sight.

2y. A tall, broad man, skin anaemic, tongue tremulous, teeth bad, with blue line on gums, suffers from attacks of bilious vomiting about once every ten days, and has sharp shooting pains down the region of the right ureter, frequently bowels very constipated. Urine loaded with urates, and bile after bilious vomiting, but gradually gets normal between the attacks. Tendon reflex entirely absent. Patches of anaesthesia on legs below knee, says he feels as though he was walking on felt, has great difficulty in going up and down stairs, there is ^{paralysis} ~~paralysis~~ of the extensors of the legs. The wrists are weak but no paralysis. Accomodation for both light and distance was paralysed. Cannot stand with eyes shut and feet together. Owing to the symptoms of plumbism present, I treated him for that, and he greatly improved and in twelve months was able to resume his employment.

Muscular tremors in the hands, arms, legs, labial muscles, and tongue, are frequent, and very often precede paralysis.

H.S. female, 21 years of age, tall, pale, foul breath, teeth bad, blue line on gums, little appetite and much dyspepsia, no colic, constipation great. Urine contains slight trace of albumen, Atrophy and paralysis of the extensors of the arms. On getting in the least excited, or attempting to use the paralysed forearms, the upper extremities, ~~was~~, tongue, and later on the

legs begin to tremble violently. Tendon reflexes absent. This patient appeared to be mending nicely, when she was seized with epidemic influenza, on the second day the paralysis extended up from the forearms all over the upper extremities, it then passed to the legs, and on the third day when she died, she was absolutely paralysed all over her body.

Out of 300 cases of plumbism, I have seen 24 affected with muscular paralysis, of these seventeen were cases of wrist drop, ten females and seven males. In all of these cases except one, the paralysis came on slowly, being preceded by muscular tremors and paresis. In one case it came on in a single night after a severe attack of colic, but the patient on being questioned, said that his hands had felt a little weak for a few days before. All the patients I have seen suffering from wrist drop, mended either wholly or in a great measure, the time varying from six to eighteen months, but I found improvement much assisted by getting the patients to wear splints to support the extensor muscles. With the exception of one very bad case of complete paralysis of the upper and lower extremities, and one case that died, all the rest of my 24 cases were rather paresis than paralysis, and it was seen in the extensors of the legs. One of the commonest complaints in plumbism is that the patient feels very weak about the legs, that they are soon tired and that they ache dreadfully.

I have had one case of ptosis due to lead poisoning. H.M. female 58, complains of drooping in the right eyelid, and a cold, numb feeling in the 4th and 5th fingers of the same side. A blue line on gums, no colic, some dyspepsia, constipation slight. Urine loaded with urates, but no albumen. Right eyelid drooped a good deal, sight not so good as it had been a few months before, accommodation not quite paralysed, but nearly so. Some patches of anaesthesia on the ulnar side of the right forearm.

Numbness and paresis of third and fourth fingers of right hand. I applied the continuous current to the paralysed eyelid, three cells being used, and the same treatment to the fingers. Tap water was discarded, and in a month, the feeling of numbness had left the fingers, and in three months the paresis of the same part was gone, and the amount of drooping in the eyelids was very slight. Since then, it has entirely disappeared and the eyesight improved.

Writers Cramp- Wm. B. printer, 49, Tall, spare man, anaemic, complained of colic dyspepsia and constipation which had been going on for twelve months, when he began to be unable to write. It began by his fingers getting tired very soon, in a few weeks after, he found that whenever he took up a pen for a few minutes, first the fingers would begin to ache, then the little and the next finger would go quite stiff and he had to drop the pen. Blue line on gums. The colic came on every night exactly three hours after going to bed, and if he went to bed later or earlier, the pain came on later or earlier. By sending him away for a complete rest, he quite recovered his health, and the cramp never returned.

Paralysis Agitans. James C. traveller, 54. Short, thin, pale, total abstainer, came complaining of weakness in the right arm and leg, and that in trying to do anything with the hand, first the right hand, then the arm would begin to shake violently. He attributed it to the fact of his always carrying a heavy sample bag on his rounds in his right hand. No blue line, some dyspepsia, no colic, urine free from albumen, no wrist drop or wasting of muscles, knee jerk increased on right side, normal the left side, no ankle clonus. He gradually got worse, and as he had occasion to go to London, I sent him to Dr. Bastian. That gentleman wrote to me saying that it was a case of paralysis agitans and advising certain treatment, but three months passed, and he

was steadily growing worse. At this time he was taken ill with pneumonia at a house in the country where well water only could be got. He recovered from his pneumonia after eight weeks in his room, but his shaking rounds were very much better. He went back to Huddersfield, and within a fortnight, they began to trouble him again. This fact led to the examination of the drinking water and urine, and they were both found to contain lead. With the discontinuance of the lead, he mended again, and though he still feels his right arm and leg weak, he is able to attend to his business again.

Excepting the one case, W.T., I have mentioned as simulating Locomotor Atascia, I have not seen the power of muscular co-ordination affected.

Electrical Stimulation. The muscles at first re-act strongly to both voltaism and faradism, but in time they lose the latter, but retain the former. The nerve loses its power of responding to both forms.

Nutritive Functions. In any case of paralysis for any length of time, atrophy of the muscles is sure to follow. Gower in his diseases of the nervous system, speaks of atrophy as accompanying rather than following the paralysis, but it has always appeared to me that the paralysis was the first to appear, followed by the atrophy. In the case of a man in whom wrist drop developed in a single night, the atrophy did not shew itself for some weeks.

K.M. female, aged 32, was seen by me when she had been indubed six months. Her history was that two years before she had lived in a house where she used lead polluted water, with the result that she had suffered from dyspepsia. After leaving the house, and taking water that contained no lead, she began to be paralysed her wrists and hands, it spread up her arms, then commenced

in her legs, spreading all over them, and from there all over her body except her head and neck. Following the paralysis, came on atrophy of the muscles, and when I saw her, the legs and arms were like sticks, the abdominal muscles, the muscles of the back, the intercostal, in fact all the muscles of the body except the head and neck were completely or partially paralysed, and very much atrophied. She was perfectly helpless, and a living skeleton. No blue line, no colic, constipation slight. She took very little food, and for six months her friends were expecting her to die every day. Iodide of Potassium was given with strychnia, and in six weeks from my seeing her, and a little over two years from the onset of the paralysis, she began to move her legs, in three months she could stand, and in six months she could use both arms and legs fairly well. At present she is as well as anyone can be, and though not stout, the muscles have all regained their normal size:

CEREBRAL & MENTAL FUNCTIONS. I have seen several cases of mental unsoundness, brought on by plumbism, hysteria being particularly common, but I think in all cases of plumbism, there is a tendency towards mental depression. It is a state of listless languor, a condition of mind and body when everything seems a trouble, and when life seems oppressed by an unaccountable burden, and when the only thing to be done is to sit down in a state of misery and let things take their course. This condition is very characteristic of lead poisoning, and every gradation of it may be observed from a mere disinclination to work to a state of absolute melancholy.

P.C. aged 21, bright, intelligent young lady, fond of everything lively and cheerful sought help in July 1890. She said she had been spitting blood, had a nasty cough, and much pain in the upper part of the right chest. Examination shewed that the chest was healthy, and there were none of the other signs of phthisis. She was sure she was going into a consumption, but

when I found she suffered from a well marked globus hystericus, and partial aphonia, was constipated, had threatened to faint, and was evidently morbidly introspective, and that the catanaemia were irregular, the case appeared to be one of functional derangement with hysterical symptoms. In a few days she expressed herself as better. She was seen five months afterwards, when in addition to the above symptoms, she had a fixed conviction that she was the subject of some serious disease. The constipation was more marked, she was perhaps a shade paler than usual, but there was no evidence of anything but functional disturbance. During the next month there was added to the other troubles, great mental depression, the patient having given up all hope of recovery, and having fixed the day upon which she should die. The constipation was worse than ever, and she complained that she had no power to expel the foeces, no colic, no blue line or anything to point to lead as the cause. She would not eat, partly because she said it was no good as she was going to die, and partly because food gave rise to distressing flatulence and pain. The patient got slowly worse, drifting on into a state of melancholy from which nothing would rouse her. About this time, she had a violent attack of colic, this drew attention to the drinking water, it was examined and found to contain a grain per gallon of lead. Her recovery after the stoppage of the lead was very slow, and it was only after about six months of treatment, that she began to admit for a moment, the possibility of her getting better. One by one her troubles passed away, and to-day she is the bright, active, intelligent young lady of old.

R.L. 50, male, Had been out of employment for some time, and got run down in health. He suffered from plumbism, had blue line and constipation. He was treated for this, but shortly afterwards began to have hallucinations of hearing. He would never do the simplest action, without first asking the permission, and receiving a reply from a voice, which he declared was that of a

gentleman in Middlesborough. Along with it he had great ideas of well being, and began ordering costly articles, and giving away cheques for fabulous sums. Hewas removed to the asylum, where I believe it is developing into a case of general paralysis.

A.L. 19 years, male, medium height. spare, pale, sought help in August 1888. Had been suffering for eight months from dyspepsia, and colicky pains in the abdomen, but on that day had discovered that that the third and fourth fingers of the left hand hung down, and he could not raise them. The same night, he was seized with violent colic, which compelled him to remain in bed. The pain kept getting worse, and on the seventh day he sent for me. I gave him an injection of morphia and atrophia, which eased the pain, but in a few hours he was seized with a convulsion, his eyes were fixed, his head thrown back and his back arched. After coming out of one he went into others, but between them there was low muttering delirium. He went on in this way for 24 hours when acute mania set in. He tried to dash out of the window, screamed and yelled at the top of his voice. He had to be constantly watched and held for four days. On regaining his senses he was found to have developed double wrist drop. At first he would move neither arms or legs, but as the weakness passed away, the actual paralysis shewed itself, it was very intractable, and at the end of two years it had not disappeared. In January 1892 he had a slight relapse, the paralysis getting worse again, and as he had not taken any tap water, we were at a loss to account for the cause, but it turned out that he had been eating preserved tomatoes from tins.

EPILEPSY & CONVULSIONS- I have seen sixteen cases of epilepsy and convulsions due to plumbism. The youngest was fifteen years and the oldest 44 years; but I believe that great numbers of infants die from convulsions during the first few months of their

lives, born of parents, who are impregnated with lead, though they may not be aware of the fact that they are suffering from plumbism. One quarter of the deaths of children under one year of age in Huddersfield is due to affections of the nervous system, quite apart from dentition.

I do not think that saturnine epilepsy differs from ordinary epilepsy, except that you get the additional symptoms of plumbism. In those families where there is a taint of epilepsy, lead poisoning is almost sure to develop it, and it sometimes is the only symptom of plumbism. There may or may not be an aura, and in bad attacks the convulsion usually commences in the hand and spreads to the rest of the body.

Petit Mal. B.D. aged 20, female, thin, tall and anaemic, complains of dyspepsia, a terrible feeling of weight in the umbilical region, and the most obstinate constipation, she also suffers from a queer feeling running up from her hand to her head, followed by about a couple of seconds unconsciousness. The attacks usually come at a fixed hour in the night, but if they happen to occur in the day, she falls, but generally has time to recover herself before she reaches the ground. Family history abundance of proof of epilepsy on her father's side. No blue line, but drinking water and urine both contained lead. Under treatment she improved, and has not had any attacks for the last twelve months.

Haut Mal. K.B. 16, female, short, stout, pale girl, no history of epilepsy in family, but she herself suffered from convulsions during her early childhood. Complains of great constipation and fits which come on about once a week, but they are gradually getting more frequent, and leave her in a very tired condition. A fit usually comes on at night and has as an aura an itching of the finger. It usually commences in her right eye, spreads all over the body and lasts altogether about a minute and a half, she then goes into a sleep for about half an hour, and wakens all right but very tired. Blue line on gums, dyspepsia, mild

colic and great constipation. Urine free from albumen between the fits, but shortly after a fit is albuminous. On discontinuing the lead, and treating the constipation the fits entirely disappeared.

S.J.S. female, 44, tall, pale and thin. Has no history of epilepsy in family.

In January 1889 was suffering from dyspepsia and constipation, when she was seized with convulsions which lasted for about ten minutes, she would then be free from them for half an hour but unconscious. She went on in this way for 48 hours, when she became ~~conscious~~ and found her wrists and hands very weak. Wrist drop developed in a few days. I had not seen her until the convulsions came on. On examination after the fits, she had a marked blue line, the urine was albuminous and contained lead. She has had no more fits, but she has only partially recovered the use of her hands.

LOCOMOTORY SYSTEM

Shooting pains in the bones, joints and muscles are frequent in plumbism, scores of cases have at first been treated for rheumatism, and the true nature of the case has only shared itself on the appearance of colic or wrist drop. Articular rheumatism is sometimes so closely simulated by plumbism, that, I have thought it worth while to compare the conditions formed in the two complaints together.

ARTICULAR RHEUMATISM

Temperature usually raised

Pulse quickened

Urine high coloured

Urine S.G. raised.

Urea increased

Sweat increased

PLUMBISM

No rise in temperature.

Pulse slowed

Urine pale.

Urine S.G. lower

Urea decreased

Sweat diminished.

Mrs. H. 32, had been at a dance, and when heated, sat in a

draught. In a few days she began to have pain in the shoulders, wrists and elbows, no swelling or redness, no history of rheumatism. In a short time the tenderness spread to the muscles of the arms, and with it was a feeling of weakness. Treatment did no good, and the patient getting anxious about herself, went when in London to see Dr. Broadbent. The following is an extract from his letter. "The cause of Mrs. H's rheumatism must I think be lead poisoning. It is altogether unlike any ordinary form of rheumatism with which I am familiar, and with the pain, there is a greater impairment of motor power, than the pain would account for. I find in each arm two points of great tenderness, at the coracoid process, apparently in the coracoid head of the biceps, the other in the origin of the extensors, from the external condyle of the humerus. It was not the bone exactly which was tender, but the tendinous structures. There are none of the usual indications of lead poisoning, the teeth are too good and too well cared for, and the gums too sound for the blue line, and there is neither anaemia or high tension pulse which one expects to find. All sorts of anomalous effects however, come from the long continued injection of small quantities of lead. in drinking water" Lead was found in the drinking water, and she gradually improved on discontinuing the poison. Cramp of the muscles is a frequent, and is occasionally seen as a precursor of paralysis. Atrophy of the muscles has been treated of under the nervous system.

The following are the factors which I think cause predisposition to plumbism, for there is no disease which seems to be more erratic in its choice of victims. I have frequently seen one out of a household affected when apparently all the other members were taking the same quantity of the poison.

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|---|---------|---|--|
| 1 | Age | 4 | Food |
| 2 | Sex | 5 | Debility from previous illness and from insanitary surroundings. |
| 3 | Alcohol | 6 | Gout. |

Age. I have shewn in a table at the beginning that much the larger proportion of cases (223 out of 300) occurred between the ages of 15 and 50.

Sex. Out of 300 cases, 220 were females, and this is not because they get more lead as the great bulk of the poorer women in this district, work in the mills along with themen. Women are more easily affected, and attacked earlier in life than men, for most of the cases from 15 to 25 years of age were females in whom lead had upset the menstrual function.

Alcohol. There can be no doubt that alcohol has a powerful influence in intensifying the effects of lead, and in causing a predisposition to plumbism. Alcohol and lead both interfere with metabolism, and check excretion, with the result that the alcohol keeps in the lead, and the lead helps to keep the alcohol in the system. Cases of plumbism amongst publicans are known to be amongst the worst to treat. Out of 24 cases of plumbic paralysis of all kinds, eleven were people who were in the habit of taking too much, and ~~thall~~ were not actually alcoholics, but occasionally got too much. When we consider the tendency there is in alsoholism to kidney disease and albumenuria, and that the great outlet for lead is through the kidneys, we can understand how alcoholics suffer more readily than other people, and the reason that the prognosis is so much more grave in their cases,.

FOOD.- Either in excess or in too small quantity predisposes to plumbism. The worst cases I have had of lead poisoning were a man and a woman who had been half fed for some months. As might be expected, food taken in excess tends to plumbism. It seems to determine the onset of the symptoms. After club dinnus wen frequently get patients suffering from colic, which turns out to be due to lead. Lead diminishes the activity of the liver and kidneys, and if with that diminished activity, extra amounts of food are taken, the blood gets loaded with just the right sort of products to determine an attack of colic, headache or

dyspepsia.

DEBILITY FROM ANY CAUSE The weakened condition after fevers or from any cause, will often determine the onset of the symptoms of plumbism, though the patient may have been taking the poison for years, without any symptoms shewing themselves.

GOUT.- The connection between plumbism and gout has been the subject of much attention for many years. Dr. Warburton Begbie drew attention to it in the Edinburgh Medical Journal for 1862, and lately Sir Dyce Duckworth in his book on gout, has a most excellent chapter upon it. I think that there can be no doubt that plumbism induces a tendency to gout, and that gout helps the manifestation of plumbism. Plumbism induces gout. It diminishes metabolism, it lowers the activity of the liver and kidneys, diminishes the excretions and secretions, in that way tending to the formation of uric acid and other products of impaired metabolism, which getting into the circulation will cause an attack of gout. I have seen several cases of gout brought on by lead polluted drinking water, but the following case is so conclusive that I relate it in preference to others: Wm.M. commercial traveller, aged 36, with no history of gout or rheumatism in the family, consulted me for a large patch of eczema which covered one buttock. It had commenced as a small pimple about a month before. After various other treatment with no good results, I gave him some lead ointment to apply to it, and in less than a week he was seized with acute articular gout in the ankle joint. He went on using the ointment as it seemed to do good, and in another fortnight he commenced with double wrist drop, the gout subsiding before it commenced.

It is now four years since he applied the ointment, the eczema is quite well, but he has not completely lost his wrist drop, and he cannot take a glass of beer, or commit the slightest excess in eating without having an attack of gout.

Gout predisposes to plumbism. I have seen this over and over

again, that where there is a history of gout in a family, plumbism shews its effects sooner, and with smaller doses, I have known $\frac{1}{15}$ of a grain per gallon of water, taken in ordinary quantities for weeks cause colic in a man with a gouty diathesis

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In the preceding pages I have endeavoured to show how lead poisoning is seen by those who practice in Huddersfield, and to emphasise the fact, that plumbism can simulate so many other complaints, that indep. the fact of Huddersfield water being polluted with lead is kept constantly in remembrance, the medical attendant may be constantly falling into error.

Arthur D Winder

Honley

Huddersfield